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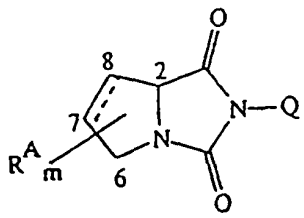
(54) Title: BICYCLIC IMIDES AS HERBICIDES



(I)

(57) Abstract

Bicyclic imides of formula (I), wherein the bond linking C-7 and C-8 may be single or double; m is 1-7; R^A can occupy one or more of the 2 or 6-8 positions and is independently selected from the group: hydroxy, halogen, CN, OR^3, (C_1-C_4)alkyl, $S(O)_nR^3$, COR^3, $C(O)SR^3$ and $C(O)NR^{11}R^{12}$; and Q is a phenylic residue substituted with one or more inorganic and/or organic residues which can be substituted, interrupted and/or combined with the aromatic residue with one or more hetero atoms such as N, O or S, preferably at least in the 4' position. These compounds are made from aryl isocyanates of the general formula Q - N = C = O and proline carboxylic acids. The compounds are useful as herbicides.

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Bicyclic Imides as herbicides

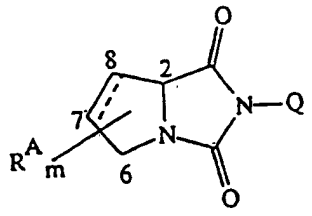
Description

This invention relates to novel bicyclic imides; a method for their preparation; and their use as herbicides.

It has already been disclosed that certain heterocyclic imides (see EP-A 272 594, EP-A 493 323, EP-B 0 070 389, EP-B 0 104 532) can be employed as herbicides.

Now novel bicyclic imides have been found that exhibit markedly better herbicidal activity with excellent selectivity.

The subject of the present invention therefore comprises compounds of formula I



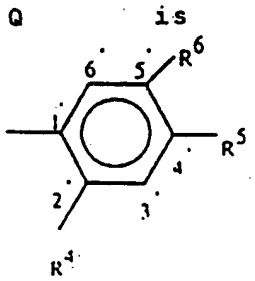
I

wherein
the bond linking C-7 and C-8 may be single or double;
m is 1 - 7;

...

R^A can occupy one or more of the 2 or 6 - 8 positions and is independently selected from the group: hydroxy, halogen, CN, OR^3, (C_1-C_4)alkyl, $S(O)_nR^3$, COR^3, $C(O)SR^3$ and $C(O)NR^{11}R^{12}$;

Q is



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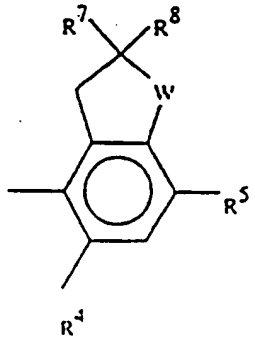

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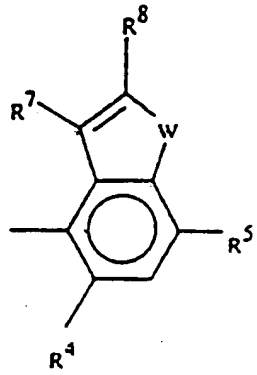

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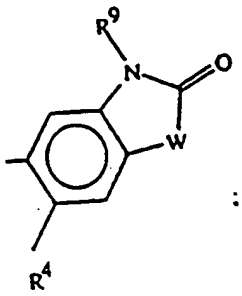

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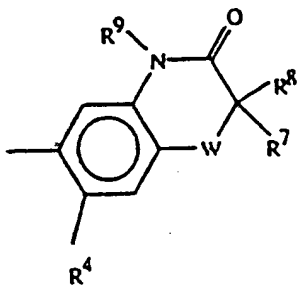

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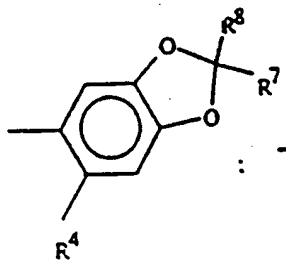
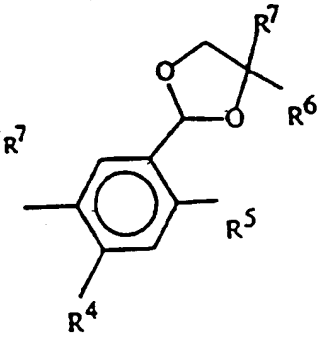


Q-6



Q-7

wherein

R^3 is (C_1-C_8)alkyl, (C_3-C_8)cycloalkyl, (C_3-C_8)alkenyl, (C_3-C_8)alkynyl, (C_1-C_8)haloalkyl, (C_2-C_8)alkoxyalkyl, (C_2-C_4)carboxy alkyl, (C_3-C_8)alkoxycarbonylalkyl, (C_4-C_8)alkenyloxyalkyl, (C_4-C_8)alkynyloxyalkyl, (C_3-C_8)haloalkoxyalkyl, (C_3-C_8)trialkylsilyl, (C_3-C_8)cyanoalkyl, (C_3-C_8)haloalkenyl, (C_3-C_8)haloalkynyl, (C_2-C_8)alkylcarbonyl, (C_2-C_8)alkoxycarbonyl, (C_2-C_8)haloalkoxycarbonyl,

$P(O)(OR^{17})_2$, $CHR^{16}P(O)(OR^{17})_2$ or $CHR^{16}P(S)(OR^{17})_2$, phenyl or benzyl optionally substituted with halogen, (C_1-C_3)alkyl, (C_1-C_3)haloalkyl or (C_1-C_4)alkoxy;

R^4 is hydrogen or halogen;

R^5 is (C_1-C_2)alkyl, (C_1-C_2)haloalkyl, OCH_3, SCH_3, $OCHF_2$, halogen, CN or NO_2;

R^6 is hydrogen, (C_1-C_8)alkyl, (C_1-C_8)haloalkyl, halogen, OR^{10}, $S(O)_nR^{10}$, COR^{10}, $C(O)SR^{10}$, $C(O)NR^{11}R^{12}$, CHO, $CH=CHCO_2R^{10}$, $CO_2N=CR^{13}R^{14}$, NO_2, CN, $NHSO_2R^{15}$ or $NHSO_2NHR^{15}$;

R^7 and R^8 are independently hydrogen, (C_1-C_3)alkyl, (C_1-C_3)haloalkyl or halogen; when Q is Q-2 or Q-6, R^7 and R^8 together with the carbon to which they are attached may be C=O;

R^9 is (C_1-C_6)alkyl, (C_1-C_6)haloalkyl, (C_2-C_6)alkoxyalkyl, (C_3-C_6)alkenyl or (C_3-C_6)alkynyl;

R^{10} is (C_1-C_8)alkyl, (C_3-C_8)cycloalkyl, (C_3-C_8)alkenyl, (C_3-C_8)alkynyl, (C_1-C_8)haloalkyl, (C_2-C_8)alkoxyalkyl, (C_2-C_6)alkylthioalkyl, (C_2-C_8)alkylsulfinylalkyl, (C_2-C_8)alkylsulfonylalkyl, (C_3-C_8)alkoxyalkoxyalkyl, (C_4-C_8)cycloalkylalkyl, (C_2-C_4)carboxyalkyl, (C_3-C_8)alkoxycarbonylalkyl, (C_5-C_8)alkenyloxycarbonylalkyl, (C_5-C_8)alkynyloxycarbonylalkyl, (C_5-C_8)cycloalkoxyalkyl, (C_4-C_8)alkenyloxyalkyl, (C_4-C_8)alkynyloxyalkyl, (C_3-C_8)haloalkoxyalkyl, (C_4-C_8)haloalkenyloxyalkyl, (C_4-C_8)haloalkynyloxyalkyl, (C_5-C_8)cycloalkylthioalkyl, (C_4-C_8)alkenylthioalkyl, (C_4-C_8)alkynylthioalkyl,

...

(C_4-C_8)trialkylsilylalkyl, (C_3-C_8)cyanoalkyl, (C_3-C_8)halocycloalkyl, (C_3-C_8)haloalkenyl, (C_5-C_8)alkoxyalkenyl, (C_5-C_8)haloalkoxyalkenyl, (C_5-C_8)alkylthioalkenyl, (C_3-C_8)haloalkynyl, (C_5-C_8)alkoxyalkynyl, (C_5-C_8)haloalkoxyalkynyl, (C_5-C_8)alkylthioalkynyl, (C_2-C_8)alkylcarbonyl, $CHR^{16}COR^{17}$, $CHR^{16}P(O)(OR^{17})_2$, $P(O)(OR^{17})_2$, $CHR^{16}P(S)(OR^{17})_2$, $CHR^{16}C(O)NR^{11}R^{12}$, $CHR^{16}C(O)NH_2$, (C_1-C_4)alkyl substituted with phenoxy or benzyloxy optionally substituted with halogen, (C_1-C_3)alkyl or (C_1-C_3)haloalkyl; benzyl optionally substituted with halogen, (C_1-C_3)alkyl or (C_1-C_3)haloalkyl; or phenyl and pyridyl optionally substituted with halogen, (C_1-C_3)alkyl, (C_1-C_3)haloalkyl or (C_1-C_4)alkoxy;

R^{11} and R^{13} are independently hydrogen or (C_1-C_4)alkyl;

R^{12} and R^{14} are independently (C_1-C_4)alkyl, or phenyl optionally substituted with halogen, (C_1-C_3)alkyl, (C_1-C_3)haloalkyl or (C_1-C_4)alkoxy;

R^{11} and R^{12} may be taken together as $-(CH_2)_5-$, $-(CH_2)_4-$ or $-CH_2CH_2OCH_2CH_2-$, in which optionally one or more H-atoms may be replaced by (C_1-C_3)alkyl, phenyl or benzyl;

R^{13} and R^{14} may be taken together with the carbon to which they are attached to form (C_3-C_8)cycloalkyl;

R^{15} is (C_1-C_4)alkyl or (C_1-C_4)haloalkyl;

R^{16} is hydrogen or (C_1-C_3)alkyl;

R^{17} is (C_1-C_6)alkyl, (C_3-C_6)alkenyl or (C_3-C_6)alkynyl;

W is O or S;

n is 0, 1 or 2;

provided that

when Q is not fused to a ring bridging the 5'- and 6'-position and C-7 and C-8 are linked by a single bond, then at least one R^A is other than hydroxy, halogen, (C_1-C_4)alkyl and (C_1-C_4)alkoxy.

The subject of the present invention comprises further bicyclic imides selected from the group consisting of 4-[4'-chloro-2'-fluoro-5'-(prop-2-ynyloxy)phenyl]-3,5-dioxo-7-fluoro-1,4-diazabicyclo-[3.3.0]octane, 4-[4'-chloro-2'-fluoro-5'-(1-methyl-prop-2-ynyloxy)phenyl]-3,5-dioxo-7-fluoro-1,4-diazabicyclo[3.3.0]octane, 4-[4'-chloro-2'-fluoro-5'-(2-propynyloxy)phenyl]-3,5-dioxo-7-chloro-1,4-diazabicyclo[3.3.0]octane, 4-[4'-chloro-2'-fluoro-5'-(1-methyl-ethoxy)phenyl]-3,5-dioxo-7,7-difluoro-1,4-diazabicyclo[3.3.0]octane and stereoisomers thereof.

In the above definitions, the term "alkyl", used either alone or in compound words such as "alkylthio" or "haloalkyl", includes straight chain or branched alkyl, e. g., methyl, ethyl, n-propyl, isopropyl or the different butyl isomers. Alkoxy includes e. g. methoxy, ethoxy, n-propyloxy, isopropyloxy and the different butoxy isomers. Alkenyl includes straight chain or branched alkenes, e. g., 1-propenyl, 2-propenyl, 3-propenyl and the different butenyl isomers. Cycloalkyl includes e. g. cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl. The term "halogen", either alone or in compound words such as "haloalkyl", means fluorine, chlorine, bromine or iodine. Further, when used in compound words such as "haloalkyl" said alkyl may be partially or fully

substituted with halogen atoms, which may be the same or different. Examples of haloalkyl include CH_2CH_2F, CF_2CF_3 and CH_2CHFCl.

More preferred are compounds of formula I having at least one of the following specifications

R^3 is preferred (C_1-C_4)alkyl, (C_3-C_6)cycloalkyl, (C_3-C_6)alkenyl, (C_3-C_6)alkynyl, (C_1-C_4)haloalkyl, (C_2-C_4)alkoxyalkyl, (C_2-C_4)carboxyalkyl, (C_3-C_6)alkoxycarbonylalkyl, (C_4-C_6)alkenyloxyalkyl, (C_4-C_6)alkynyloxyalkyl, (C_3-C_6)haloalkoxyalkyl, (C_3-C_6)trialkylsilyl, (C_3-C_6)cyanoalkyl, (C_3-C_6)haloalkenyl, (C_3-C_6)haloalkynyl, (C_2-C_6)alkyl carbonyl, $P(O)(OR^{17})_2$, (C_2-C_6)alkoxycarbonyl, (C_2-C_6)haloalkoxycarbonyl, $CHR^{16}P(O)(OR^{17})_2$ or $CHR^{16}P(S)(OR^{17})_2$, phenyl or benzyl optionally substituted with halogen, (C_1-C_3)alkyl, (C_1-C_3)haloalkyl or (C_1-C_4)alkoxy;

R^5 is halogen or CN;

R^6 is hydrogen, (C_1-C_4)alkyl, (C_1-C_4)haloalkyl, halogen, OR^{10}, $S(O)_nR^{10}$, COR^{10}, CO_2R^{10}, $C(O)SR^{10}$, $C(O)NR^{11}R^{12}$, $CH=CHCO_2R^{10}$, $CO_2N=CR^{13}R^{14}$, $NHSO_2R^{15}$ or $NHSO_2NHR^{15}$;

R^7 and R^8 are independently hydrogen, (C_1-C_3)alkyl or (C_1-C_3)haloalkyl; when Q is Q-2 or Q-6, R^7 and R^8 together with the carbon to which they are attached may be C=O;

R^9 is (C_1-C_4)alkyl, (C_1-C_4)haloalkyl, (C_2-C_4)alkoxyalkyl, (C_3-C_6)alkenyl or (C_3-C_6)alkynyl;

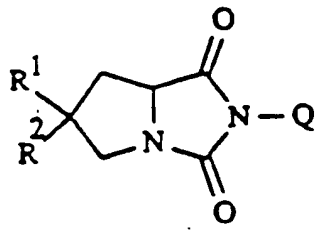
R^{10} is (C_1-C_4)alkyl, (C_3-C_6)cycloalkyl, (C_3-C_6)alkenyl, (C_3-C_6)alkynyl, (C_1-C_4)haloalkyl, (C_2-C_4)alkoxyalkyl, (C_2-C_4)alkylthioalkyl, (C_2-C_4)alkylsulfinylalkyl, (C_2-C_4)alkylsulfonylalkyl, (C_3-C_6)alkoxyalkoxyalkyl, (C_4-C_8)cycloalkylalkyl, (C_2-C_4)carboxyalkyl, (C_3-C_6)alkoxycarbonylalkyl, (C_6-C_8)alkenyloxycarbonylalkyl, (C_6-C_8)alkynyloxycarbonylalkyl, (C_6-C_8)cycloalkoxyalkyl, (C_4-C_6)alkenyloxyalkyl, (C_4-C_6)alkynyloxyalkyl, (C_3-C_6)haloalkoxyalkyl, (C_4-C_8)haloalkenyloxyalkyl, (C_4-C_6)haloalkynyloxyalkyl, (C_6-C_8)cycloalkylthioalkyl, (C_4-C_6)alkenylthioalkyl, (C_4-C_6)alkynylthioalkyl, (C_4-C_8)trialkylsilylalkyl, (C_3-C_4)cyanoalkyl, (C_3-C_6)halocycloalkyl, (C_3-C_6)haloalkenyl, (C_5-C_6)alkoxyalkenyl, (C_5-C_6)haloalkoxyalkenyl, (C_5-C_6)alkylthioalkenyl, (C_3-C_6)haloalkynyl, (C_5-C_6)alkoxyalkynyl, (C_5-C_6)haloalkoxyalkynyl, (C_5-C_6)alkylthioalkynyl, (C_2-C_4)alkyl carbonyl, $CHR^{16}COR^{17}$, $CHR^{16}P(O)(OR^{17})_2$, $P(O)(OR^{17})_2$, $CHR^{16}P(S)(OR^{17})_2$, $CHR^{16}C(O)NR^{11}R^{12}$, $CHR^{16}C(O)NH_2$, (C_1-C_2)alkyl substituted with phenoxy or benzyloxy optionally substituted with halogen, (C_1-C_3)alkyl or (C_1-C_3)haloalkyl; benzyl optionally substituted with halogen, (C_1-C_2)alkyl or (C_1-C_2)haloalkyl; or phenyl and pyridyl optionally substituted with halogen, (C_1-C_3)alkyl, (C_1-C_3)haloalkyl or (C_1-C_4)alkoxy;

R^{12} and R^{14} are independently (C_1-C_2)alkyl, phenyl optionally substituted with halogen, (C_1-C_2)alkyl, (C_1-C_2)haloalkyl or (C_1-C_2)alkoxy;

R^{11} and R^{12} may b taken together as $-(CH_2)_5-$, $-(CH_2)_4-$ or $-CH_2CH_2OCH_2CH_2-$, each ring optionally substituted with (C_1-C_2)alkyl, phenyl or benzyl;
R^{13} and R^{14} may be taken together with the carbon to which they are attached to form (C_3-C_6)cycloalkyl;
R^{17} is (C_1-C_4)alkyl, (C_3-C_6)alkenyl or (C_3-C_6)alkynyl.

Compounds having a substituted proline residue, particularly in 7-position, exibit a beneficial effect on undesired plants, preferred are fluoro, bromo or chloro.

Particularly preferred method of use employs compounds of formula II



II

in which
R^1 is hydrogen, halogen, (C_1-C_4)alkyl, OR^3, $S(O)_nR^3$, COR^3, CO_2R^3 $C(O)SR^3$ $C(O)NR^{11}R^{12}$ or CN;
R^2 is halogen, (C_1-C_4)alkyl, OR^3, $S(O)_nR^3$, COR^3, CO_2R^3 $C(O)SR^3$ $C(O)NR^{11}R^{12}$ or CN.

Especially preferred method of use employs compounds of formula II in which at least one of R^1 - R^3 has the meaning

R^1 = hydrogen or (C_1-C_4)alkyl;
R^2 = fluoro, chloro, bromo, OR^3, $S(O)_nR^3$, CO_2R^3, $C(O)NR^{11}R^{12}$ or CN;
R^3 = (C_1-C_4)alkyl, (C_3-C_6)cycloalkyl, (C_3-C_6)alkenyl, (C_3-C_6)alkynyl, (C_1-C_4)haloalkyl or (C_3-C_6)trialkylsilyl.

Most preferred method of use employs compounds of formula II with at least one of the following specifications

R^1 = hydrogen,
R^2 = fluoro, chloro, bromo or OR^3,
R^3 = (C_1-C_2)alkyl, (C_1-C_2)haloalkyl,

and in Q
R^4 is fluoro or chloro;
R^5 is chloro;
R^6 is OR^{10}, CO_2R^{10}, $NHSO_2R^{10}$ or SR^{10};
R^7 is hydrogen;
R^8 is hydrogen or methyl;
R^9 is (C_3-C_4)alkenyl or (C_3-C_4)alkynyl;
R^{10} is (C_1-C_4)alkyl, (C_3-C_6)cycloalkyl, (C_3-C_6)alkenyl, (C_3-C_4)alkynyl, (C_1-C_3)haloalkyl, (C_2-C_4)alkoxyalkyl, (C_3-C_6)alkoxycarbonylalkyl, (C^6-C^8)alkenyloxycarbonylalkyl, (C^6-C^8)alkynyloxycarbonylalkyl or (C^1-C^2)carboxyalkyl.

If not otherwise specified the invention relates to both the individual possible stereoisomers of formula